



Development of a Novel Kneepad for Mining and other Kneeling-intensive Occupations



NIOSH – OMSHR – Human Factors Branch – MSD Prevention Team

Background and Objective



Figure 1. Low-seam underground coal miners

- In 2007, 84 knee injuries (averaging \$13,121 per injury) were reported to MSHA for seam heights of 30" – 54".
- Large forces and stresses are transmitted to the knees while kneeling and crawling.
- Kneepads are designed to protect the knee from floor hazards.
- The effect of kneepads on the forces and pressures on the knee was not known.

A need exists to improve the design of kneepads currently utilized in the low-seam coal mining industry.

The objective of this study is to design a novel kneepad that:

1. reduces the forces, stresses, and moments at the knee while in postures associated with low-seam mining;
2. is durable enough to withstand the mining environment; and
3. is well-accepted by the mine workers.

Qualitative Research

NIOSH researchers conducted focus group sessions with underground coal miners to identify kneepad characteristics that will maximize acceptance.

3 types of focus groups conducted:

1. User problems – identified functional problems and undesirable characteristics associated with kneepads currently being utilized by underground coal miners
2. User design ideas – determined characteristics of kneepads that are considered desirable to underground coal miners
3. User acceptance – identified level of acceptance and document problems and undesirable characteristics of 1st generation prototype



Figure 2. 1st Generation NIOSH Prototype

Experimental Research

NIOSH researchers quantified the forces, stresses, and moments at the knee while in postures associated with low-seam mining.

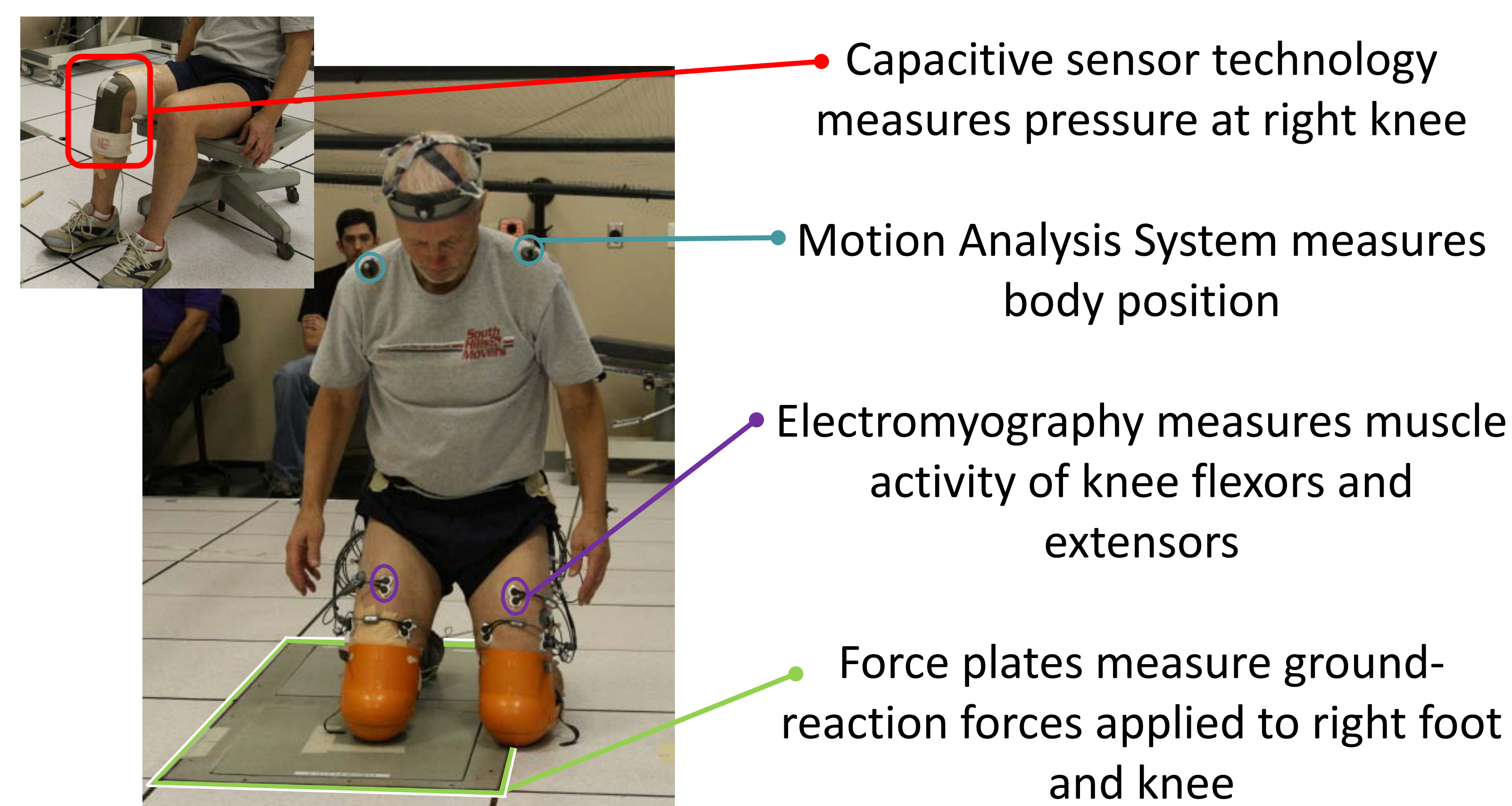


Figure 3. Subject simulating mining posture

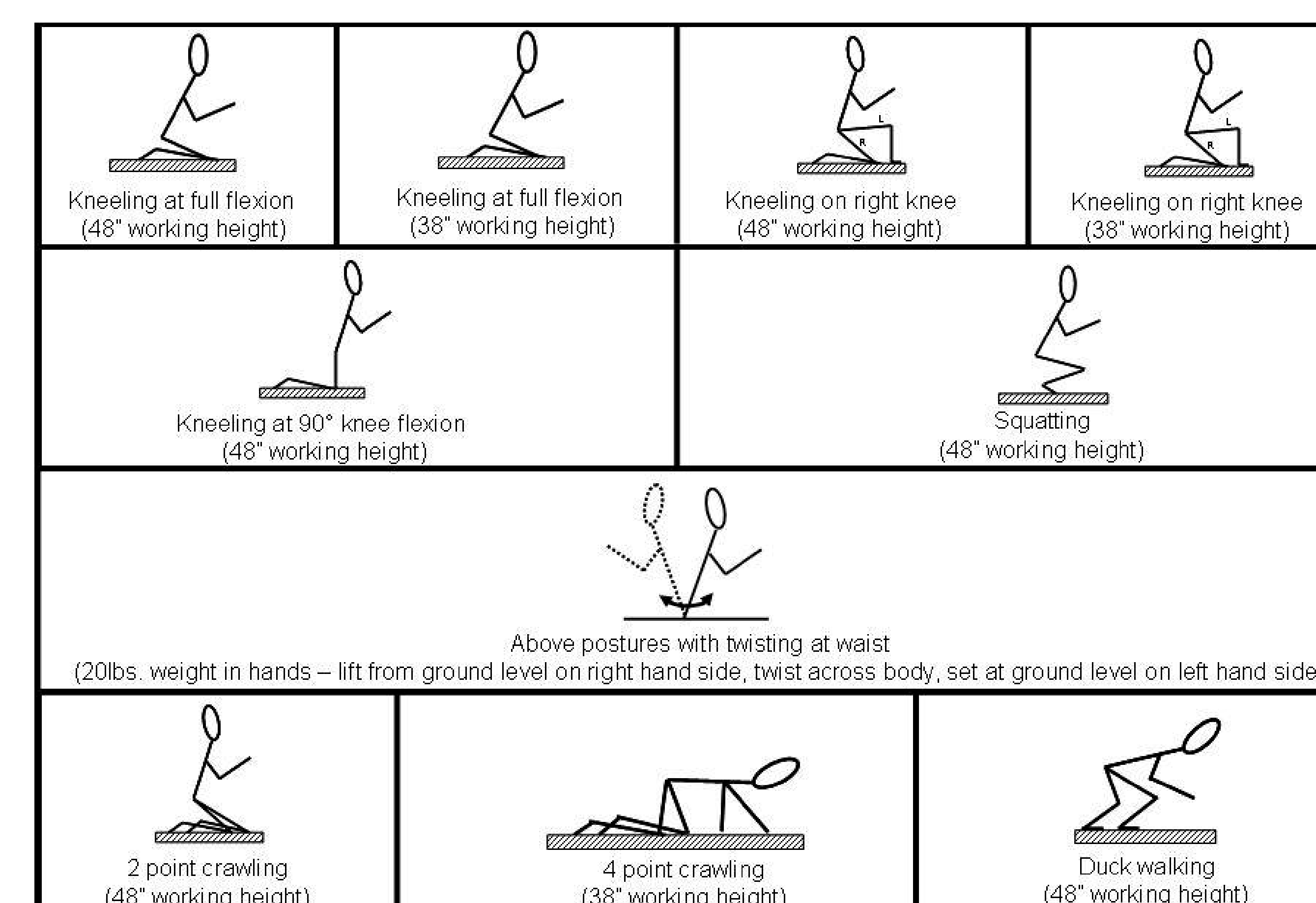


Figure 4. Schematics of postures simulated in study.
Postures included were selected based on observational studies and from interviews



Figure 5. Kneepads used in study

Current and Future Work

Once NIOSH researchers develop a viable prototype, this kneepad will be evaluated to ensure its usability and efficacy, then field tested where its performance will be compared to user selected controls.

Usability and Preliminary Durability Testing

Usability testing will be conducted to ensure the kneepad performs as expected and does not introduce any new hazards. Questions to be addressed include:

- Does the kneepad stay in place?
- Is the kneepad easy to keep clean?

As part of this week-long usability testing, the durability of the kneepad will be examined to ensure the design can withstand the harsh mining environment.



Figure 6. Kneepads commonly used by low-seam coal miners

Efficacy Testing

Once acceptable usability and durability is achieved, the efficacy of the kneepad will be evaluated to demonstrate the kneepad's performance in reducing knee forces, stresses, and moments.

Field Testing

Field evaluations of the kneepad will be conducted to evaluate the NIOSH prototype kneepad against user-selected controls while being utilized in low-seam mines (evaluations occur at 0, 1, 3, and 6 months of usage). This testing will investigate durability and acceptance by mine workers and determine any necessary alterations to the design.

Acknowledgements

We would like to acknowledge our many collaborators on this project:

- The Rooster Group
- University of Pittsburgh
- Rockwood Casualty Insurance Company
- The Art Institute of Pittsburgh
- Coal Mines: Parkwood Resources, Rox Coal, TJS Mining, East Fairfield Coal Company, Rosebud Mining, Amfire Mining, Murray Energy